Commercial Observation for Spatio-Temporal Monitoring for Indications of Change

Ashwini Deshpande | Program Manager | January 7th 2026

Intelligence Advanced Research Projects Activity

IARPA

Creating Advantage through Research and Technology

COSMIC: Commercial Observation for Spatio-Temporal Monitoring for Indications of Change

PROGRAM DESCRIPTION

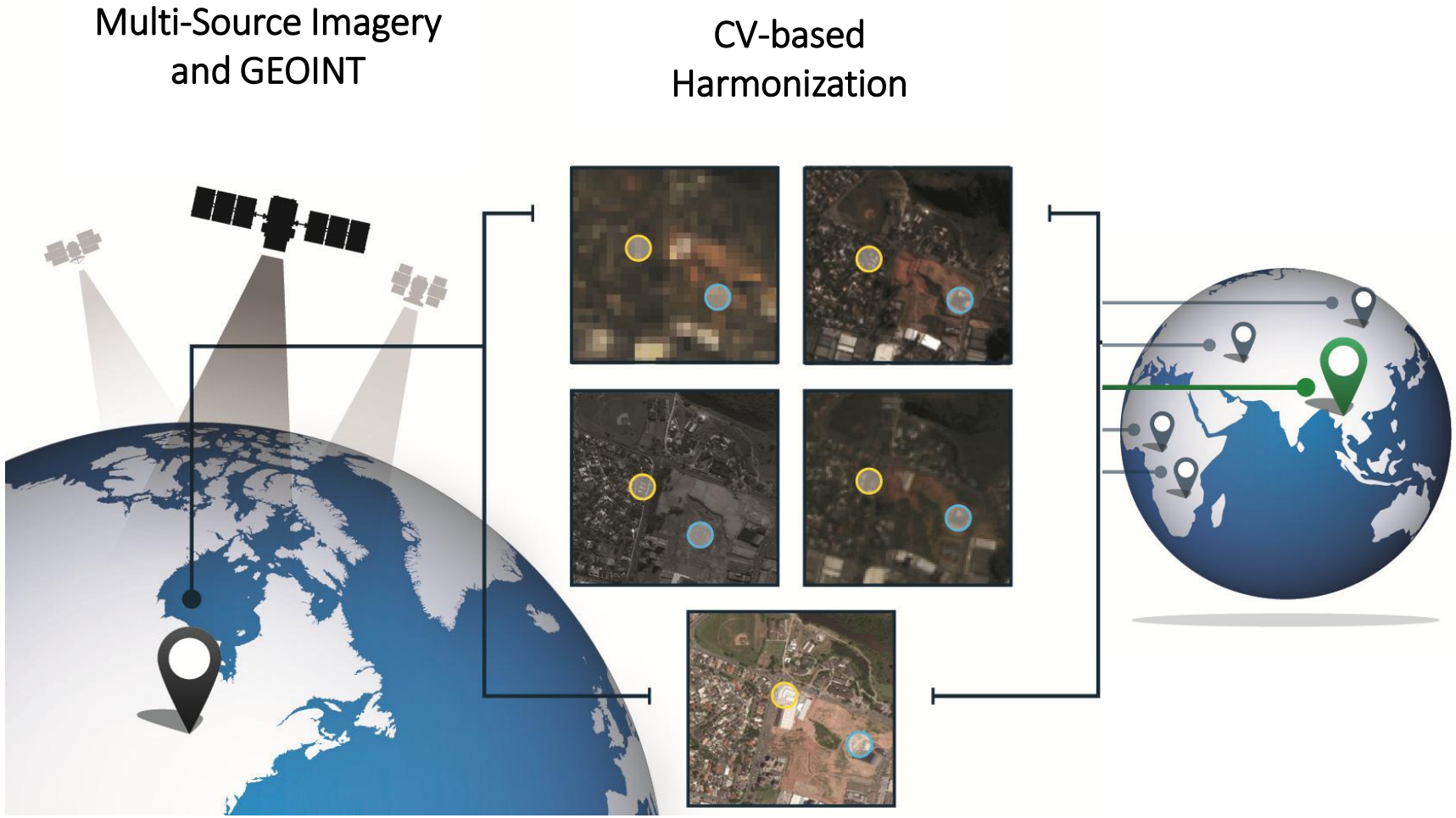
COSMIC enables the analysis of multi-source satellite imagery and geolocated information through the automated creation of a persistent data source with harmonized information into shared embedding framework suitable for interaction with Agentic AI systems and human visualization.

MISSION IMPACT

COSMIC will leverage a harmonized, persistent data source that integrates various commercial remote sensing data. This source will allow us to monitor Earth for changes to reference and foundational information.

Approach

Advancements in deep learning, computer vision, and retrieval augmentation generation enable us to align disparate data and predict missing information due to temporal, spatial, spectral gaps.



The Problem

- Industry is accelerating in Agentic AI and GEOINT integration
- IC use cases require adaptation of these commercial tools
  - Ability to train systems with relevant data is limited
  - Different resources, different needs, different constraints

Leverage Geospatial AI for the benefit of the IC

COSMIC GOALS

- Build a system that can bridge the gap to make agentic systems work with any available GEOINT or imagery data
- Create outputs to facilitate human understanding of reasoning
- Fully automated processes to increase the speed of incorporating recent information into the data source

COSMIC Inputs

- Data across all available sources
- Ingests new data sources
- Agnostic about imaging modalities, resolutions, and view angles
- Accepts non-imagery geospatial information

COSMIC Features

- Visualizable for the humans
- Confidence metrics that accompany output
- Fully automated

Enable commercial agentic AI to work with IC GEOINT for multi-source analysis

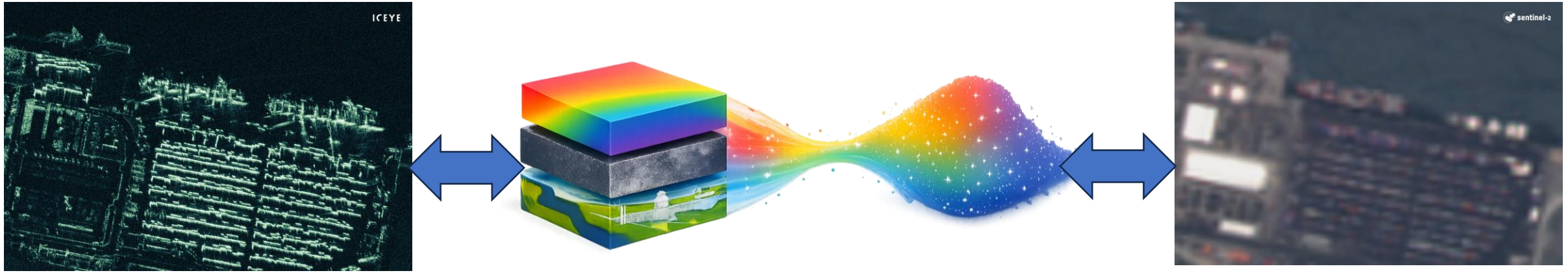
How is Harmonization Done Now

- Physics Based Approaches are at their limit
  - Onerous and computationally expensive – too slow to generate the volume of imagery required to enable computer vision solutions.
  - Human interactions are often required to incorporate new information, viewpoints and sensors.
  - Decimation of imagery to harmonize versus super-resolution
- Generative AI Approaches
  - Diffusion methods show promise, but hallucinations can be limiting.
  - Need to continue advancing work between EO/SAR or absent spectral bands
  - Advance progress towards arbitrary viewpoint generation

Hallucinations need to be understood, mitigated, and flagged with confidence metrics

The Pseudo Persistent Data (PPD) Source

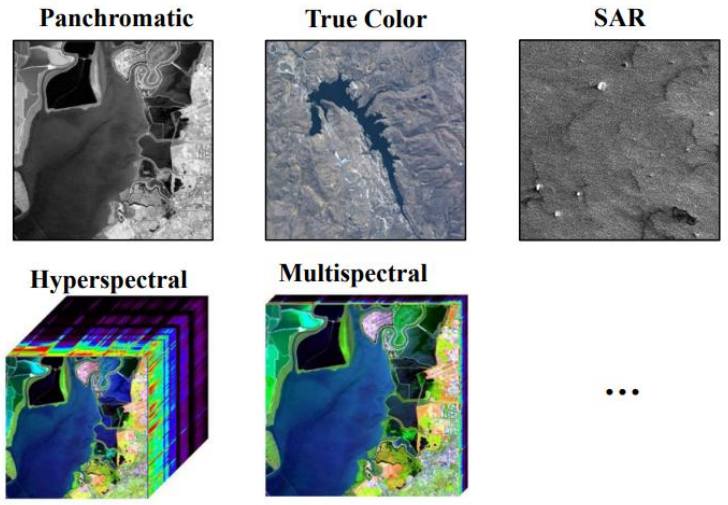
- Multiple data sources need to be interrelated for improved understanding
  - Rapid incorporation of new sources
  - Inclusion of non-imagery geospatial data, such as weather and traffic
  - Address collection, resolution gaps through predictive processes
- Generate imagery based on inputs as needed
  - Arbitrary modality, viewpoints, and other parameters
  - Visualize imagery in intuitive forms

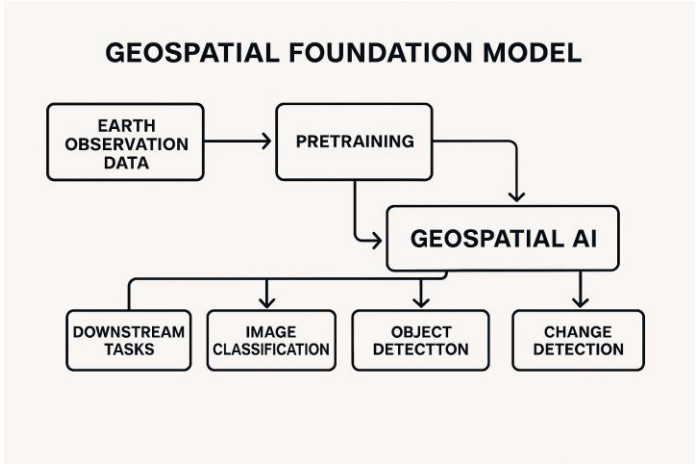


Enhancing Geospatial Foundation models for the IC

Existing Geospatial foundation models

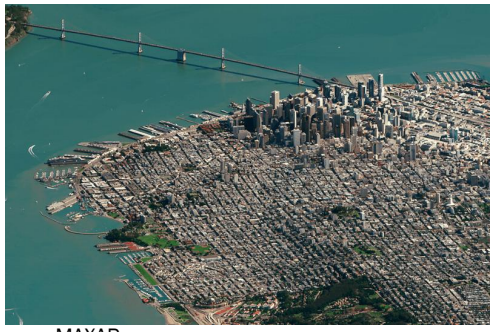
Example GFM



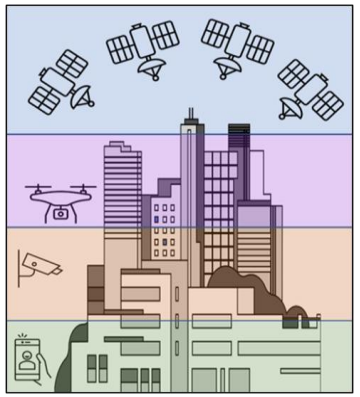


COSMIC Enhancements

- Incorporate newly collected imagery, non-nadir viewpoints and novel sensors from all altitudes, quickly
- Predict through temporal, spectral, and resolution gaps
- Co-locate and Co-register imagery
- Visualizable for the humans, interpretable for the AIs, **with confidence metrics**


MAXAR


AI Image of Satellite



Expected Operation

GEOINT Sources

Maps

EO

Polygons

Weather

SAR

Reporting

Commercial AI

Answers

How many tanks are there in Ukraine?

IC Analysts

What does this SAR image look like in EO?

Running Agents on SAR and EO

High Res Tanks

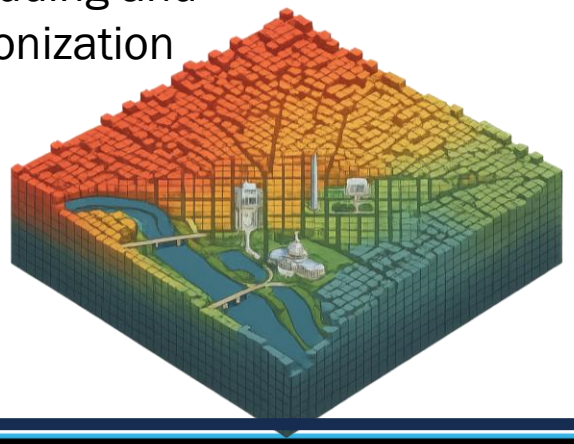
EO Converted SAR

15m Pan Imagery

This change detection algorithm only accepts PAN imagery at 15m resolution

Algorithms

Embedding and Harmonization



Data Generation

HSI Datacube

I need a stack of hyperspectral imagery over Jacksonville to test my new algorithm

Researchers

Pseudo-persistent Data Cube

Notional Data Sources

- Various Imagery sources may be used, and expanded upon during program
  - EO/Hyperspectral – Ex: Worldview, Planet, LANDSAT, Sentinel 2, OSK
  - SAR – Ex: Sentinel 1, Capella, Umbra
  - Non-satellite imagery – Ex: Cell phones, security cameras, drone
- Non image, but geolocated sources may also be leveraged
  - Polygons - Building footprints, road networks, map layers
  - Temporal Data – weather and hydrological data, traffic data
  - Text and point sources – News reports, building permits, safety alerts

Systems will be systematically exposed to data sources to exhaustively test delivered capabilities

Metrics Under Consideration

- Performance on Downstream Tasks
  - Measure accuracy and speed of change and object detection algorithms across domains
  - Validate query responses for intelligence questions
- Adaptability to New Systems
  - Test ability to ingest new sensors or constellations without retooling algorithms.
  - Benchmark performance when introducing novel data types mid-cycle.
- Data Generation Quality
  - Compare generated imagery against holdout sets for:
    - Spatial accuracy (object placement, geometry)
    - Spectral fidelity (band consistency)
    - Temporal realism (correct time-of-day or seasonal cues)
    - Track hallucination rate and confidence scores for generative outputs

Metrics may evolve during the program and we are open to industry input and feedback

T&E Approach

- Rapid testing and evaluation schedule
  - Evaluations every 3 months, with feedback shortly thereafter
  - Challenge events will crank up in difficulty as performers tackle various problems
  - Will be measuring performance along multiple dimensions and data combinations
- Code and Containers will be submitted to our test harness
  - T&E will run on holdout data sets, may include new data types
  - Will apply benchmark algorithms and tasks to measure performance
- T&E will be using AI to design tests for performer systems and evaluate the results
- Promising systems will be transitioned to partners continuously throughout the program lifetime

Continuous, adaptive testing to fully understand and extend system capabilities and limits

Out of Scope Topics

- Retraining a full AI backbone like Gemini or Chat GPT
  - Also, no building AI Agents, but T&E will use a suite of them to test solutions
- Building a full, fresh geospatial foundation model
- Building novel change detection algorithms or other specific use cases
  - Benchmark algorithms will be selected and used for test and evaluating

We may revise this list during the pre-solicitation period

Schedule

- Aggressive 18 month schedule
- Quick evaluations, with rapid turnarounds before site visits every 3 months to discuss innovations and evaluation results.
  - These are likely to be a mix of in person and virtual discussions

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Evaluations																		
Site Visits/CDR																		
Workshop																		

Thank you!

We're excited to get this program started and work with you!

Questions? Contact: COSMIC@iarpa.gov